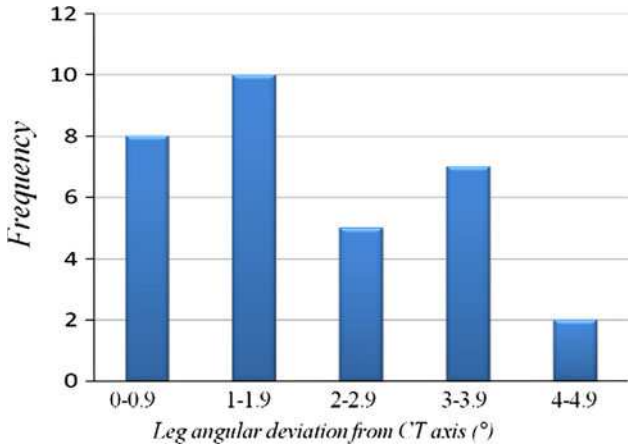

Fig. 1 Range of absolute deviations measured

the literature only the slices around the knee are used with no reference to the overall leg.

When measuring anatomical features of the knee to plan joint replacement surgery it had been observed that patients were generally not exactly aligned with the axis of the CT scanner. The objectives of this study were to measure the amount of misalignment typically encountered, determine its effect on TTTG measurements and provide a method of compensating for misalignment.

Methods: Thirty-two anonymised patient datasets were analysed. Each dataset contained hip, knee and ankle data. Hips and ankles were scanned with an increased slice spacing to reduce X-ray exposure. The legs were axially aligned by rotating the scans until the posterior condyles were level. Landmarks were placed on the femoral head surface and a spherical least-squares fit obtained to determine head centre. Landmarks were placed on the talus centre (a slice was chosen where it appeared trapezoid and the crossing point of lines between the four corners was computed). The angle of the line from the femoral head centre to the talus centre was then measured in the AP view, relative to the longitudinal axis of the CT scan.

Results: Figure 1 shows the deviations measured. The mean absolute deviation was 1.9°. Both varus and valgus deviations occurred.

A geometrical model of the geometry of the TTTG measurement was made using typical knee dimensions—a TTTG of 18 mm and a distance of 70 mm between the femoral and tibial measurement slice. It was calculated that each 1° of alignment error caused a TTTG measurement under- or over-estimate of approximately 1.1 mm.

In the study, this indicates a TTTG measurement error on average of approximately 2 mm, and up to 5.5 mm in the worst case observed.

Conclusions: It has been shown that patients are not always scanned with their legs straight in the CT scanner. In many cases the error will be small, however outliers may cause mis-classification of the extent of the TTTG distance.

By determining the deviation of the limb from the scanner axis using proximal and distal landmarks, it is possible to estimate the TTTG error and compensate, allowing measurements to be made irrespective of leg alignment.

P28-1158

Patello-femoral kinematics in relation to medial patello-femoral 'ligament'

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Objectives: Understanding of the patello-femoral joint pathology, its natural history, rationale for various treatments and evaluation of their efficacy is currently challenged by the lack of standardized information on the kinematics of this joint. In this setting, studies are needed to analyze association between the morphology of the joint in relation to the distal femur, its restraints and kinematics. Starting from the hypothesis that the medial patellofemoral 'ligament' (MPFL) is only a restraint during motion, against a load inducing lateral shift, functioning as an aponeurosis, to guide the patella through a trochlear groove that is related to the trans-epicondylar and posterior condylar axis, this study wants to analyze the morphology of the patello-trochlear joint and its influence on patello-femoral kinematics with reference to the presence or absence of the medial patellofemoral restraint.

Methods: This is a time zero, in vitro study. A kinematic analysis of six cadaveric knees, three of each side, was performed recording with a navigation system the passive flexion–extension range of motion (ROM) between 10° and 120°, using the center point of patella as reference over posterior condylar and mechanical axis of the femur. Patello-femoral kinematics was recorded under an axial quadriceps load of 60 N, with free tibial rotation and eliminated femoral anteversion. Patella kinematic tests were conducted with and without a lateral load of 25 N, to evaluate tilt and lateral shift in two different anatomical condition, with natural and without the medial patellofemoral ligament.

Results: A wide variation in MPFL femoral insertion was noted. In comparison to the MPFL-intact state, the patella lateralized the path in MPFL-deficient state, even without lateral load. The variability in kinematics could not be explained on the basis of variation in trochlear morphology. MPFL was anisometric, the insertion points of the inferior bundles coming closer in flexion.

Conclusions: While, MPFL may guide the patella shift and tilt during knee motion, in normal knee trochlear morphology does not influence kinematics. The ligament act only as a passive restraint and its complex anatomical structure allows it to be anisometric during range of motion.

P28-1184

In vitro measurement of native patella kinematics in different loading conditions and motor tasks

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Objectives: Clinical problems of the knee joint are often related to the patella. Despite this, patella biomechanics has not been investigated to a great extent dynamically but mainly in passive or quasi-static conditions. The objective of this study was to document patella kinematics in different loading conditions and motor tasks, using a well defined methodology.

Methods: Twelve fresh frozen full leg cadaver specimens were tested. Frames with reflective markers were rigidly fixed to tibia, femur and patella and a computed tomography (CT) scan was made. Femur and tibia were embedded, properly aligned in frontal and sagittal planes. Medial and lateral hamstrings tendons were prepared for attachment to constant load springs (50 N each). The quadriceps tendon was prepared to be clamped to the motor of a knee rig.

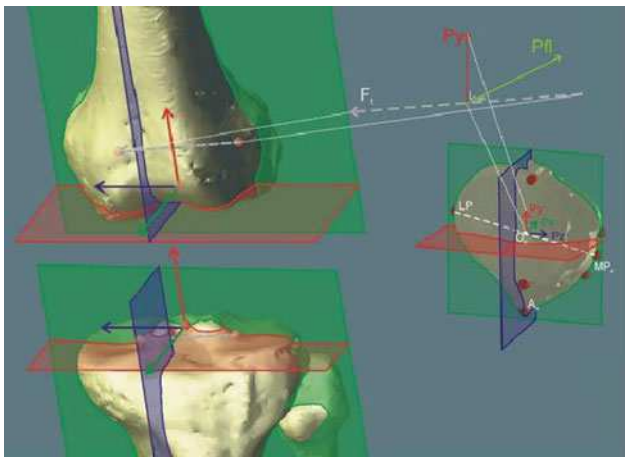

Fig. 1 3D models of the bones were used to identify landmarks and define coordinate frames. Patella marker trajectories were then transformed to following rotations and translations: patella flexion (around F_t), rotation around Pfl) and tilt (around Py); anteroposterior (AP), mediolateral (ML) and inferior-superior (IS) translations, all along the coordinate axes of the femur

The knee rig provides 6° of freedom to the knee joint. It simulated loaded open chain and squatting motions while infrared cameras recorded the marker trajectories.

Four motor tasks were tested: passive motion, open chain extensions with and without a weight of 30 N fixed to the distal tibia, and squats with constant vertical ankle force of 130 N. During each motor task, four muscle load combinations were tested: quadriceps only, quadriceps + medial hamstrings, quadriceps + lateral hamstrings and quadriceps + both hamstrings.

Patella kinematics was calculated using the coordinate system in Fig. 1 and is reported as a function of knee flexion angle.

Results: Variability among specimens was high, but some consistent motion patterns were clearly visible. On average, patella flexion was linearly related to knee flexion. We found almost constant patella rotation, tilt and ML translation. The patella shifted almost linearly posteriorly and inferiorly with increasing knee flexion. There were some differences in kinematics between motor tasks. Compared to squatting, passive and open chain motions showed more patellar flexion and a more inferior and posterior position of the patella. During passive motion, the patella gradually rotates externally compared to squatting. Patella tilting and ML translation were the same for all motor tasks. Hamstrings forces only affected patella flexion in motor tasks with small quadriceps force.

Conclusions: The objective of this study was to investigate patella kinematics and how it is influenced by motor task and muscle load. This was done in a reproducible and reliable way. The data show that patella kinematics is indeed different between motor tasks, mainly due to differences in quadriceps forces. Hamstrings loads, though important for tibio-femoral kinematics, have less impact on patella kinematics.

P28-1217

The biomechanical relationship between Anterior Knee Pain Syndrome (AKPS) and Functional Hallux Limitus (FHL). A case series review

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Objectives: To determine the close relationship between AKPS and the presence of FHL. Demonstrate that the sagittal plane blockade caused by the Flexor Hallucis Longus tendon entrapment at the retrotalar pulley is a major predisposing factor for AKPS of unexplained origin. Describe a conservative and surgical treatment protocol for patients with AKPS and FHL.

Methods: A prospective cohort of patients with AKPS, whose physical therapy program failed and were treated with endoscopic retrotalar release of the Flexor hallucis longus (Fhl) tendon, was compared with a retrospective cohort of patients treated conservatively with success. A complete orthopaedic examination was performed to exclude any other possible etiology for AKPS. FHL was diagnosed with a specific stretch test. Conservative treatment consisted of subtalar manipulation, unlock of the subtalar joint with the Hoover cord maneuver, muscular strengthening and propioceptives exercises. Surgical treatment consists of section of the retrotalar pulley endoscopically. For both cohort of patients a questionnaire for data collection was done.

Results: Patients with AKPS who were treated for FHL in the same time, conservatively or surgically, show a high rate of treatment success with disappearance of symptoms. When conservative treatment fails the surgical release is a safe and effective procedure to restore normal biomechanics in the PF joint. High rate of patient's satisfaction is found in this series without complications.

Conclusions: There exists a strong relation between AKPS and FHL. Location of the pain on the medial aspect of the patello-femoral joint can be explained by the asynchronism in gait and a modification in impact forces at heel strike followed by an hyperpronation in final stance phase. Treatment of the FHL, conservatively or surgically, is a good safe and reliable strategy in patients with AKPS of unexplained origin.

P28-1232

The value of the MPFL suture for acute patella luxation in consideration of risk factors

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Objectives: Patella dislocation is an injury often found in young, physically active patients. In cases of lateral dislocation of the patella, it is generally accompanied by an injury of the MPFL (medial-patella-femoral-ligament), which has been identified over the last few years as the main soft tissue stabilizer of the patella. Conservative treatment of acute patella dislocation leads to high rates of recurrent dislocation (30–60%) and thus to dissatisfactory results for young and active patients. An established procedure to treat patella dislocation is to gather the medial ligament complex (Yamamoto sutures). This procedure implements unspecific suturing of the medial patellar ligament and does not take risk factors into consideration.

MRT diagnostics permit the exact localization of the MPFL injury (near the patella, femoral or mid-substance). This allows the exact treatment of the injured MPFL with local sutures.

Methods: In this study, 50 patients (27 men, 23 women) with acute patella dislocations were examined prospectively, underwent arthroscopic surgery, and were treated with a local suture. Following the clinical examination, MRT and X-ray diagnostics were done to determine the precise location of the rupture, to assess accompanying injuries (particularly cartilage lesions) and to record other anatomical variables (degree of trochlear dysplasia, Insall Salvati index, TTTG distance, trochlear SLOPE, Patella-TILT).

After 1 year p.o., subjects underwent a clinical re-examination with MRT diagnostics to assess the medial patellar ligament complex, changes in Patella-TILT, and to monitor accompanying injuries of the cartilage. In addition, subjects were questioned about their ability to